EUROPEAN SYNCHROTRON RADIATION FACILITY
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ESRF

Experiment title:
DETERMINATION OF THE FRACTAL DIMENSIONALITIES OF AGGREGATES BY ANOMALOUS SMALL-ANGLE SCATTERING OF X-RAYS UNDER GRAZING INCIDENCE

Experimental number:
HS 284

Beamline:	**Date of experiment:**		**Date of report:**
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Report:

Experimental

The wavelength used on ID01 beamline was chosen at 7100 eV, just below the iron threshold in order to avoid Fe fluorescence and to study in a first run all our samples because some of them had iron aggregates.

In order to work under grazing incidence, the horizontal and vertical slits were adjust to define a beam cross-section of 200 x 80 μm^2.

All the x-ray path was under vacuum from the sample to the 2D gas detector; the sample to detector distance can be changed from 0.8 m to 4.6 m depending on the investigated q range down to 5.10^{-3} $Å^{-1}$.

Furthermore, a reflectivity curve can also be made with each sample in order to check its critical angle, and consequently to analyze by GISAXS either the surface of the layer or to penetrate into it. In such a way, very interesting results were obtained on the different sizes of iron or silver aggregates at the top or inside the analyzed layers.

Results

Antimony aggregates: Our goal was to determine the fractal dimension of the aggregates by another technique than transmission electron microscopy which is GISAXS in order to enhance surface sensitivity and to obtain a reliable information on the height of the aggregates. The Sb aggregates were deposited on graphite (HOPG). Unfortunately, the used substrates had not highly oriented planes and the pattern showed an important scattering on a freshly cleaved substrate. The scattering was however much more important on the substrates covered with antimony aggregates, nevertheless it was not possible to deduce the real scattering of the aggregates because the natural mosaicity of graphite leads to a non trivial determination of the critical angle.

As the scattering from Sb aggregates does exist and is quite important, the experiment is undoutebly possible with either a very flat HOPG graphite or another flat substrate like sapphire for instance. However this last possibility has to be check first by TEM in order to see the fractal morphology of the antimony aggregates.

Cobalt aggregates in multilayers: the expected interest was to determine by the GISAXS technique the relevant parameters in order to correlate the magnetic properties with the structure of the aggregates. Due to the high brilliance of the ESRF beam the scattering patterns (and the mean sizes of the aggregates) of the multilayer [(30Å Al_2O_3/1Å Co)30] and the monolayer (27Å Al_2O_3/2Å Co/50Å Al_2O_3) have been obtained. This has not been observed at LURE. The 2D pattern of the multilayer with only 1 Å Co is shown in the figure here under. This pattern is very different from the others containing larger Co thicknesses.

Here the scattering is quite isotropic, with no correlation between layers. It is not exactly a liquid-like because we find a mean distance Λy = 26 Å in the plane of the layer and Λz = 33 Å in the in-depth direction. The average size of the aggregates being 10 A.